VOYAGER OBSERVATIONS OF 1985U1. P. Thomas and J. Veverka, Cornell University.

Introduction. Of the 10 small Uranian satellites, 1985U1 is the largest and the only one for which a resolved image was obtained by Voyager 2. In terms of albedo, the other nine satellites seem to be similar to 1985U1 (Smith et al., 1986). Thus the single image of 1985U1 is important in suggesting what these other objects may be like.

Size and Shape. Figure 1 shows the limb and terminator outline of the satellite viewed from 61° latitude, 78° longitude. The limb of the satellite can be measured to subpixel precision by techniques reported by Dermott and Thomas (1986). Scans across the limb can be used to locate the edge of the disk to about 0.3 pixels. The resultant line and sample coordinates are scaled to kilometers using the range and camera focal length (Davies and Katayama, 1981). The center was located approximately from the position of the terminator and from the phase angle. Direct measurement of the long and short dimensions gives 82 km and 77 km, respectively; an ellipse fit to the limb using the same center coordinates gives axes of 78 and 76 km. Thus the satellite's average radius is somewhat less than 77 km, and, at least in the orbital plane, the satellite is not greatly elongated. The dimension perpendicular to the orbital plane is unknown.

Surface Features. One crater, approximately 45 km across, is near the terminator. Two other possible craters are visible, but there is no basis for attempting crater counts, or making any statements concerning crater morphology.

Photometry. We have used a Minnaert function to approximate the photometric behavior of the surface of 1985U1. Such an approximation works well on other Uranian satellites for which extensive data were obtained. Additionally, in the case of 1985U1, the irregular shape of the satellite introduces more serious uncertainties into any photometric analysis than do details of the photometric function employed. We sampled the disk by two methods, one a grid search of every other pixel, the other interactively selected 2×2 pixel boxes. At each point we assumed that

$$I/F = B_0\ (\alpha)\ \mu_0^{k}\ \mu^{k-1}$$

where $\pi F \cos i$ is incident solar flux, I is scattered intensity, μ_0 is the cosine of the incidence angle (i), μ is cosine of the emission angle (ε), k is the Minnaert limb darkening parameter, and α is the phase angle. Assuming an ellipsoidal shape allows a least squares fit from the Minnaert parameters of B_0 and k. The two sampling methods give nearly identical results:

$$k = 0.65 \pm 0.06 \qquad B_0 = 0.043 \pm 0.002$$

These values appear reasonable. For comparison with the Moon at α = 33°, B_0 = 0.058 and k = 0.60 (Helfenstein and Veverka, 1986), while both Titania and Oberon have k $\simeq$ 0.7 at this phase angle.

To obtain an estimate of the satellite's geometric albedo and normal reflectance we must extrapolate the B_0 value determined at 33° to $\alpha = 0°$. Considering the overall similarity between the physical properties of 1985U1 and those of Phoebe, a reasonable guess for β_i would be 0.024 mag/deg, the average value found for Phoebe by Thomas et al. (1983). The resulting geometric albedo would be 0.09, with $m_v = 20.5$. Of the five larger satellites of Uranus, Voyager phase data are most complete for Titania. Analysis of disk-resolved photometry shows that for Titania B_0 increases by a factor of 1.63 in going from $\alpha = 33°$ to $\alpha = 0°$, corresponding to an effective value of $\beta_i = 0.016$ mag/deg. Since Titania is considerably brighter than 1985U1, this value is likely to be a lower limit to β_i for 1985U1. Thus, $p > 0.069$ and $m_v < +20.8$, consistent with the estimate made above.

Discussion. In size and shape, as well as in albedo, 1985U1 seems to be generally similar to Saturn's satellite Phoebe. (The average radius of Phoebe is about 110 km.) Although we lack spectral data on 1985U1, if this satellite resembles the other satellites of Uranus for which data are available (Smith et al., 1986), then it has an almost neutral gray color very similar to that of Phoebe. The importance of the 1985U1 image is that it provides the best tie-in of the normal reflectance of any of the newly discovered satellites with that of the five larger ones and with that of the rings. In this respect 1985U1 is considerably darker than the darkest of the larger satellites (Umbriel) and is a little brighter than the currently accepted albedo for the ring particles (about 0.05, according to Smith et al., 1986).

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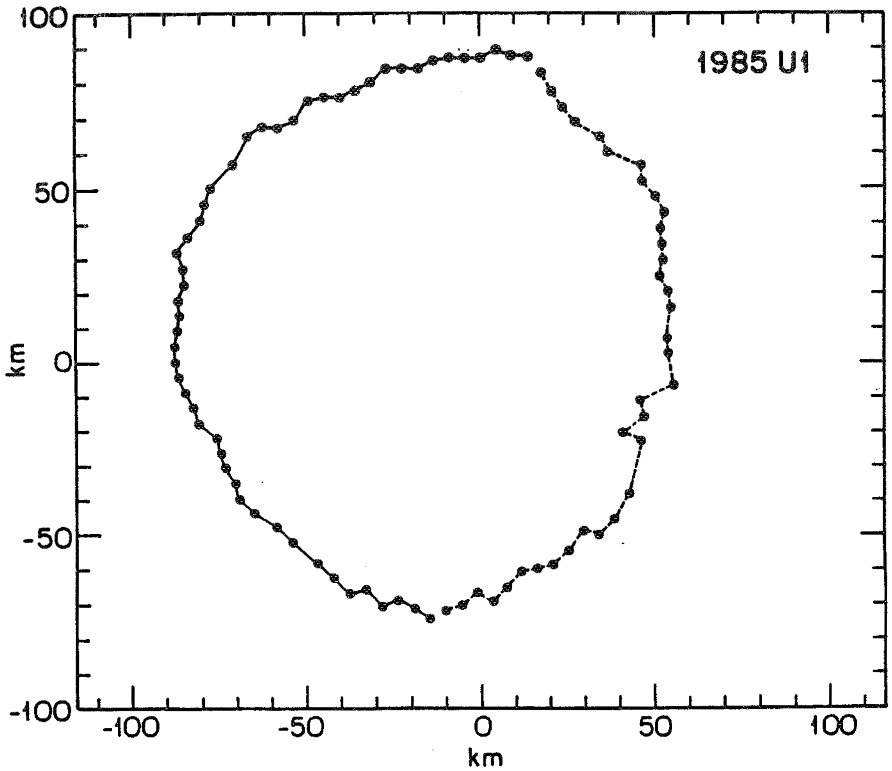

Figure. Outline of limb and terminator of 1985U1. Terminator points connected by dashed lines.

1985U1 Summary

Orbit:	$a = 86000 \pm 50$ km
	$P = 18.3$ hrs
Spin Period:	Probably synchronous (18.3 hrs)
Size/Shape:	Apparent radii in image: 82 × 77 km
	Ellipse fit: 78 × 76 km
	Average radius: < 77 km
Photometry:	Minnaert parameters at $\alpha = 33°$ $\begin{cases} B_0 = 0.043 \pm 0.002 \\ k = 0.65 \pm 0.06 \end{cases}$
	Estimated geometric albedo 0.07-0.09
	Estimated opposition magnitude $m_V \sim +20.5$-21